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Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: a prospective study

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The Alvarado score was assessed as to its accuracy in the preoperative diagnosis of acute appendicitis. A series of 49 consecutive patients was studied prospectively over a period of 9 months in two hospitals (Gateshead and Sunderland). The presence of a high score was found to be an easy and satisfactory aid to early diagnosis of appendicitis in children and men. However, the false-positive rate for appendicitis in women was unacceptably high.

Acute appendicitis is by no means an easy diagnosis to make and can baffle the best. This is particularly true in the early stages of the disease. A failure of early diagnosis can lead to progression of the disease with its attendant morbidity and occasional mortality.

A negative appendicectomy rate of 20–44% is not unusual in the surgical literature and many surgeons would accept a negative appendicectomy rate of up to 30% as inevitable *(1)*. Although aids exist to enhance diagnosis, these are either complex or not easily available when most needed. A scoring system described recently by Alvarado *(2)* was designed to reduce the negative appendicectomy rate without increasing morbidity and mortality *(3)*. This present study aims to evaluate the usefulness of this scoring system in patients with a provisional diagnosis of acute appendicitis in a district general hospital.

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Materials and methods

Over a 9-month period, 49 patients who were ill enough to warrant surgery for suspected appendicitis were evaluated. The scoring system was initially introduced as an adjunct to diagnosis in order to correct a previous high false-positive appendicectomy rate. The scoring system, as described by Alvarado, is based on three symptoms, three signs and two laboratory findings (Table I) *(2)*. Patients with a score of 1–4 were not considered likely to have acute appendicitis; those patients with a score of 5–6 were considered to have a possible diagnosis of appendicitis, but not convincing enough to warrant immediate surgery, these were marked for further review. Those with a score of 7–8 were considered to have a probable acute appendicitis and those with a score of 9–10 were considered to have an almost definite acute appendicitis and submitted to surgery. The Alvarado

Table I. The Alvarado score

Symptoms	*Score*
Migratory RIF pain	1
Anorexia	1
Nausea/vomiting	1
Signs	
Tenderness: right iliac fossa	2
Rebound tenderness RIF	1
Elevated temperature	1
Laboratory	
Leucocytosis	2
Shift to the left of neutrophils	1
Total score	10

score can increase or decrease on reassessment. The laboratory finding of leucocytosis is defined as a white cell count in excess of 10×10^9/litre.

In this study we used a slightly modified version of the Alvarado score by excluding one laboratory finding: shift to the left of neutrophils maturation (score 1). This was not available from our laboratory on a routine basis and therefore our patients were scored out of 9 rather than 10 points. In our series patients with scores of 7–9 underwent an appendicectomy while those with a score of less than 7 were not considered for surgery unless there were compelling reasons to do otherwise. If after 24 h observation, regardless of the score, patients were thought on clinical grounds to require appendicectomy, then this was performed. The female patients, if considered candidates for appendicectomy, were usually laparoscoped first to confirm or refute the diagnosis (in 10 cases). If the appendix was found not to be inflamed the patient was included as a false-positive in the series and appendicectomy not performed.

Results

Our assessment categorised the patients into three groups: men, women and children. The results are summarised in Table II. First, considering those patients with high Alvarado scores (over 7), overall they indicate a false-positive rate of 14.6%. In the male group, appendicitis was confirmed histologically in 14 of the 15 cases, a sensitivity of 93% (proportion of true-positives). In the female group, 10 of the 15 women had histologically proven appendicitis, producing a sensitivity rate of 67%. In addition, all 11 children who had high Alvarado scores had histologically proven appendicitis (sensitivity rate of 100%). A final diagnosis was made in all women. Gynaecological conditions were predominant in women who had a normal appendix. Pelvic inflammatory disease (3), ruptured ovarian cyst (1) and inflammatory bowel disease (2). A final diagnosis could not be made in the one man with a normal appendix. He made an uneventful recovery.

Of those patients who went to theatre with Alvarado scores of 5–6, six were men and two were women. Four of the men (67%) and one of the women (50%) had appendicitis. These patients were the only ones to have their diagnosis delayed, but this was not directly attributable to the scoring system and they would have been observed for a period regardless.

Table II. Results of the Alvarado score

	No of patients	*Score* $\geqslant 7$	*Appendicitis*	*Sensitivity*
Men	21	15	14	93%
Women	17	15	10	67%
Children	11	11	11	100%
		Score < 7		
Men		6	4	67%
Women		2	1	50%
Children		0	0	0

No patient required surgery who had a score less than 5.

Discussion

The results demonstrate quite effectively that the Alvarado scoring system carries a false-positive rate which varies according to group. However, as those with low scores were not operated on, conclusions on false-negatives have to be circumspect. As far as is known, all patients who had low scores were discharged and did not subsequently require an appendicectomy for appendicitis.

The Alvarado score is simple to use and easy to apply, since it relies only on history, clinical examination and a basic laboratory investigation. Our study illustrates that this simple scoring system in patients suspected of having acute appendicitis works extremely well in children and men. However, in women, particularly those of child bearing age, it falls disappointingly short of expectations. Even with scores of 7 or more, over 30% did not have an inflamed appendix. Unnecessary surgery was, fortunately, avoided in these patients as laparoscopy conferred the final diagnostic step such that the negative appendicectomy rate equalled that of the males.

Our own findings are supported by a larger study by Owen *et al. (3)* involving 215 patients over a 12-month period with similar conclusions. However, the negative appendix rate in women in our series using the Alvarado score was higher (33% *versus* 22%). In conclusion, the Alvarado scoring system is effective in children and men, but diagnostic laparoscopy is advised to minimise the unacceptably high false-negative rate in women.

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